EPISTEMOLOGICAL BELIEFS, ATTITUDES AND CONCEPTUAL UNDERSTANDING TOWARDS LEARNING PHYSICS AMONG PHYSICS EDUCATION UNDERGRADUATES

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To my dearest family and friends,

My appreciation is beyond words. My thoughts and prayers are always with you all.

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ABSTRACT

This research is to study the epistemological beliefs, learning attitudes and conceptual understanding towards learning Physics among the first year and final year Physics Education undergraduates (N = 68) from Universiti Teknologi Malaysia for 2009/2010 session. This is a descriptive quantitative research. Data is collected by using two instruments, namely the Physics Epistemological Beliefs and Attitudes Test (PEBAT) and the Force Concept Inventory (FCI). In the pilot study, internal consistency (α = .790) and (α = .712) are found for the epistemological beliefs category and learning attitudes category respectively whereas the FCI has the reliability of .650. Collected data is analyzed by using SPSS version 16.0. The findings show that the mean scores obtained by the overall undergraduates in epistemological beliefs test and learning attitudes test are 69.05% and 72.10% respectively. The results indicate that generally the undergraduates hold high sophistication of epistemological beliefs and favorable attitudes in learning Physics. However, poor conceptual understanding due to misconceptions is detected among them as only one person (1.47%) of the total undergraduates is able to develop coherent understandings in Newtonian force concept (M = 24.47, SD = 11.18). Gender differences are detected in both epistemological beliefs and learning attitudes tests which are in favor of female undergraduates. The t-tests show that there are statistically significant differences in mean scores between first and final year undergraduates for epistemological beliefs as well as learning attitudes. Higher mean scores in both aspects are in favor of the final year undergraduates. Pearson correlations show that there are significant relationships between epistemological beliefs and conceptual understanding (r = .607, p < .01), between epistemological beliefs and learning attitudes (r = .563, p < .01) as well as between learning attitudes and conceptual understanding (r = .496, p < .01).

ABSTRAK

Kajian ini bertujuan untuk mengkaji kepercayaan epistemologi, sikap belajar dan kefahaman konseptual terhadap pembelajaran Fizik di kalangan pelajar-pelajar tahun pertama dan tahun akhir dari jurusan Pendidikan Fizik (N = 68) di Universiti Teknologi Malaysia bagi sesi 2009/2010. Kajian ini ialah kajian kuantitatif berbentuk deskriptif. Data dikutip dengan menggunakan dua instrumen, iaitu *Physics Epistemological Beliefs and Attitudes Test* (PEBAT) dan *Force Concept Inventory* (FCI). Dalam kajian rintis, indeks kebolehpercayaan (α = .790) dan (α = .712) telah diperoleh bagi kategori kepercayaan epistemologi dan kategori sikap belajar masing-masing manakala indeks kebolehpercayaan bagi FCI ialah .650. Data yang diperoleh dianalisis dengan menggunakan SPSS versi 16.0. Dapatan kajian menunjukkan min skor yang diperoleh oleh pelajar-pelajar dalam ujian kepercayaan epistemologi dan ujian sikap belajar ialah 69.05% dan 72.10% masing-masing. Keputusan tersebut menunjukkan secara keseluruhan, pelajar-pelajar mempunyai tahap sofistikasi yang tinggi bagi kepercayaan epistemologi serta menunjukkan sikap belajar yang positif terhadap pembelajaran Fizik. Namun demikian, kefahaman konseptual yang lemah yang dipercayai berpunca daripada masalah miskonsepsi telah dikesan di kalangan pelajar. Analisis data menunjukkan hanya satu orang (1.47%) daripada jumlah pelajar yang dikaji berjaya menguasai kefahaman konseptual dalam konsep daya Newtonian (M = 24.47, SP = 11.18). Dapatan kajian menunjukkan terdapat perbezaan yang signifikan di antara jantina bagi ujian kepercayaan epistemologi dan ujian sikap belajar yang mana keputusan kedua-dua ujian tersebut adalah memihak kepada pelajar perempuan. Ujian t-test menunjukkan terdapat perbezaan yang signifikan di antara pelajar-pelajar tahun pertama dan tahun akhir bagi kepercayaan epistemologi dan sikap belajar yang mana min skor yang tinggi dalam kedua-dua aspek adalah memihak kepada pelajar tahun akhir. Analisis korelasi Pearson menunjukkan terdapat hubungan signifikan antara kepercayaan epistemologi dengan kefahaman konseptual (r = .607, p < .01), antara kepercayaan epistemologi dengan sikap belajar (r = .563, p < .01) dan antara sikap belajar dengan kefahaman konseptual (r = .496, p < .01).

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CLASS	-	Colorado Learning Attitudes about Science Survey
CU	-	Conceptual Understanding
EB	-	Epistemological Beliefs
EBAPS	-	Epistemological Beliefs Assessment for Physical Science
FCI	-	Force Concept Inventory
GEBEP	-	Greek Epistemological Beliefs Evaluation Instrument for Physics
ISS	-	International Space Station
LA	-	Learning Attitudes
MDT	-	Mechanics Diagnostic Test
MPEX	-	Maryland Physics Expectation Survey
PEBAT	-	Physics Epistemological Beliefs and Attitudes Test
TESL	-	Teaching English as Second Language

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The success of Dr. Sheikh Muszaphar Shukor bin Sheikh Mustapha, our first Malaysian astronaut to travel in outer space and landed in International Space Station (ISS) has become an inspiration to the younger generation to embrace science and technology. This will also encourage more students to study in science stream in their secondary level of education and hopefully will propel them to be actively involved in the study of science domain subject related course or major in subject like Physics in their coming tertiary education. Learning Physics is important as Physics is essential and we need the knowledge of Physics to understand the world around us, the world inside us, and the world beyond us. One of the important aims highlighted in the Physics education's syllabus compiled by Curriculum Development Centre (2006) is to provide students with knowledge and skills in Physics and technology and enable them to solve problems and make decisions in everyday life based on scientific attitudes and noble values. It is important for students to acquire the knowledge of Physics in dealing with everyday life activities. Hence, it is equally important to study from the students' point of views, their epistemological beliefs and learning attitudes towards Physics and learning Physics.

Epistemology is defined as the study or a theory of the nature and grounds of knowledge, especially with reference to its limits and validity (Merriam-Webster, 2003). Kortemeyer (2007) described epistemological beliefs about Physics and

Physics learning as the beliefs which concern with what constitutes knowledge in Physics and how knowledge in Physics is developed. Paulsen and Feldman (2005) defined epistemological beliefs as the systems of implicit assumptions and beliefs that students have about the nature of knowledge and its acquisition. Epistemological beliefs involve learners' theories about knowing, the nature of knowledge, and knowledge acquisition (Schommer, 1990). Meanwhile, the word "attitudes" is defined as the favorable or unfavorable responses to things, places, people, events or ideas (Koballa, 1995). According to Seifert (1991), an attitude is learned and is defined as the acquisition of certain feelings about something or someone, either positively or negatively that influence one's choices of action in a consistent way. Sprinthall *et al.* (1994) defined attitude as a learned predisposition to respond either positively or negatively to persons, situations or things. The terms epistemological beliefs and attitudes when applied in the context of students' Physics learning, one can understand students' epistemologies as their beliefs or views about how knowledge in Physics is constructed, evaluated and also students' manner, stance or approach towards learning the subject Physics. So the epistemological beliefs and attitudes of students towards learning Physics are defined as students' view or way of thinking towards the study of Physics. It is how students think about the knowledge, their knowing in learning Physics and the way they approach the learning.

The term "conceptual understanding" is sometimes called intuitive understanding and it refers to an ability to recognize underlying concepts in a variety of different representations and applications (Richardson and McCallum, 2003). For an example, a student who understands the concept of "velocity" knows that it is the rate of change of position for an object in the moving direction. Furthermore, with good conceptual understanding of the velocity concept, the student is able to identify the slope on a displacement-time graph as displacement over time or also known as velocity and the coefficient of variable, t in a formula giving its position as a function of time, t are all manifestations of the same underlying concept, and knows how to translate between them. Richardson and McCallum (2003) emphasized that in learning Physics, students need conceptual understanding first to develop a sound understanding of key fundamental concepts then using a deeper approach and more sophisticated skills to make the learning become meaningful.

According to Schommer (1990), students' epistemological beliefs influence learning approaches and subsequently learning outcomes. Apart from that, students' learning strategies and learning outcomes are also influenced by their personal belief systems about the nature of knowledge and learning, their epistemological beliefs and attitudes. Hence, a student's personal epistemological beliefs and attitudes towards learning Physics may influence the way they learn and how they master their learning. Hofer and Pintrich (2002) described that epistemological beliefs affect Physics understanding through their indirect effect on learning, text comprehension, and metacomprehension strategies, an argument which is also made by Ryan (1984) and Schommer *et al.* (1992). Hofer and Pintrich (1997) have also suggested that epistemological beliefs can influence academic achievement indirectly, by affecting goal orientation. In other words, epistemological beliefs can give rise to certain types of learning goals, such as mastery, performance, and completion goals, which in turn, can function as guides for cognitive and metacognitive strategy use. Settle and Knobloch (2004) revealed that the ways that people know and process knowledge are guided by a set of assumptions and beliefs. These beliefs and attitudes influence how students learn in their college courses and also guide how students acquire, structure, and process the knowledge. The way how students think about the knowledge, its structure and its acquisition process may well reflect the way how students response to the subject itself. Therefore, study on epistemological beliefs and attitudes of students towards learning Physics is needed to tap into the students' mind frame to investigate their beliefs and perception towards Physics and the attitudes towards learning the subject.

1.2 Research Background

Over the decades, the subject of study on epistemological beliefs of students towards learning has been intensively carried out to investigate the students' beliefs, perceptions, attitudes and epistemologies towards the process of acquiring knowledge. Epistemological beliefs have gradually become a central focus in educational research because it's been shown to play an important role in the learning process and predict many aspects of learning process (Malaki *et al.*, 2009).

Beginning with Schommer (1990) who studied on how students' beliefs about the nature and acquisition of knowledge influence their approach to learning. Hofer and Pintrich (1997) studied on how students interpret their learning experiences and the influence of epistemological beliefs on reasoning when engage in learning process. Sinatra and Pintrich (2003) studied on the impact of epistemological belief sophistication on students' skills and attitudes towards learning which focus on the aspects of critical thinking, self-regulation, cognitive flexibility, ability to communicate ideas, and to learn from collaboration. It was not until the late 90's the study of epistemological beliefs of students towards learning started to shift and focus more on specific domain subjects in the like of Science and Physics. Since then Physics education research community has extensively begun to do research on the study of students' attitudes, expectations and epistemologies towards learning Physics.

In recent years, there have been several popular studies conducted which are related to the relationship between students' epistemology, attitudes and the learning of Physics. Among them were like survey done by Redish *et al.* (1998) to investigate students' expectations in university Physics by using Maryland Physics Expectations Survey (MPEX), study conducted by Elby *et al.* (1997) to probe students' epistemologies and to investigate their views about the nature of knowledge and learning in the physical sciences by using Epistemological Beliefs Assessment For Physical Science (EBAPS), study conducted by Stathopoulou and Vosniadou (2006) to explore the relationship between Physics-related epistemological beliefs and Physics understanding using Greek Epistemological Beliefs Evaluation Instrument for Physics (GEBEP) and study on students' beliefs about Physics and learning Physics by using The Colorado Learning Attitudes About Science Survey (CLASS) which was carried out by Adams *et al.* (2006). According to Brewe *et al.* (2009) who conducted a study on positive attitudinal shifts in introductory Physics measured with CLASS described that conceptual understanding in Physics is one of many characteristics that distinguish experts from novices, but other attitudinal characteristics discriminate novice and experts as well. These attitudes are not merely a like or a dislike of Physics, but a broader evaluation of cognitive attitudes toward the nature of Physics and the practice of Physics. Apart from that, there are also a few studies on epistemological beliefs based on

gender differences. However, the studies on effects of gender on epistemological beliefs are inconclusive and produce different results. Schommer (1993) in a study investigating the epistemological beliefs across gender reported that girls are less likely to believe in quick learning and fixed ability than boys. On the contrary, Belenky *et al.* (1986) argued that at the early developmental stage of personal epistemological beliefs, females view knowledge as handed down by authority while males view knowledge as mastering what is handed down by authority.

Students' conceptual understanding in Physics is also considered as one of the important main subjects to be studied for Physics educationist researchers. McDermott (1984) first studied the student understanding of the concept of velocity in one dimension. He then investigated the student understanding of the concept of acceleration in one dimension a year later. McDermott (1984) also conducted research on conceptual understanding of mechanics to study student understanding of isolated concepts in the field of mechanics. Halloun and Hestenes (1985) first developed an instrument called the Mechanics Diagnostic Test (MDT) which was used to diagnose student conceptual understanding in mechanics. The MDT was used to assess students' qualitative conceptions of motion and its causes. Hestenes *et al.* (1992) then improvised the MDT to create the Force Concept Inventory (FCI) which is used to test students' conceptual understanding in Newtonian force concept. FCI is considered as the most widely used assessment instrument to investigate students' conceptual understanding of Newtonian force concept (Henderson, 2002). Until now, FCI is still widely used to test students' conceptual understanding in introductory Physics. Based on a study conducted by Stathopoulou and Vosniadou (2006) on exploring the relationship between Physics-related epistemological beliefs and Physics conceptual understanding, the researchers suggested that there is a relationship between Physics-related epistemological beliefs and Physics conceptual understanding. Students with high level of epistemological beliefs tend to archive a deep, coherent understanding of Newtonian force concept compared to those who have lower level of Physics-related epistemological beliefs.

Epistemological beliefs and learning attitudes are important aspects that may affect students' approach in learning Physics and extensive study on those aspects need to be carried out. Although epistemological beliefs and learning attitudes have

been the subject of extensive research for so many years in Western countries, but less similar research has been done in non-Western countries. So far there has yet to be any detailed study or education research to investigate students' epistemological beliefs towards learning Physics among our Malaysian students. Thus, this study is carried out with the aims to examine the Universiti Teknologi Malaysia, Physics education undergraduates' epistemological beliefs and learning attitudes towards Physics and their conceptual understanding in Newtonian force concept in Physics. The Physics education undergraduates are involved in this study as they are the pre-service Physics teachers in the country. Hence, it is important to prepare the future Physics teachers with good epistemological beliefs and attitudes in learning Physics so that they project good image of Physics discipline to students as well as to look for evidence of conceptual understanding in the teacher's ability to understand and mastering the Newtonian force concept in Physics.

1.3 Statement of Problem

Rohana and Shaharom (2008) in a study on "Relationship between laboratory work and form 4 Physics students' achievement in the topic of force" reported that generally students failed to master the conceptual understanding of force in Newtonian force concept in Physics and they were poor in giving correct answers to problems which related to force and motion. Inevitably, students fail to develop good understanding of the force concept despite being exposed to the basic concept of force in their earlier stage of science education in form two at secondary schools. Poor conceptual understanding about force and motion among pre-service Physics teachers were also found in a Turkish research conducted by Bayraktar (2007). The study shows that the students are weak in understanding and applying the concept of force in problem solving and generally are poor decision makers when come to deal with force concept problems. Generally speaking, a student requires good conceptual understanding in Physics in order to master the subject. However, according to Gray *et al*. (2008), other factors like epistemological beliefs and learning attitudes also play a substantial role in a student's ability to learn and understand Physics concepts. He described that students' epistemological beliefs

towards Physics and the structure of Physics knowledge, their beliefs about the connection between Physics and the real world, their epistemological beliefs in problem solving and their attitudes in learning Physics are all equally important as well. Therefore, this study is initiated with the aims to determine the epistemological beliefs, learning attitudes held by the pre-service Physics teachers in Universiti Teknologi Malaysia and to study their conceptual understanding in Newtonian force concept.

1.4 Research Objectives

This research is aimed to study the Universiti Teknologi Malaysia, Physics education undergraduates' epistemological beliefs and attitudes towards learning Physics as well as their conceptual understanding in Newtonian force concept in Physics. Therefore, the objectives of this study are to look at the three main aspects, namely epistemological beliefs, learning attitudes and conceptual understanding. There are a total of 10 research objectives in this research. The following statements are the research objectives according to the aspects studied which involved the Physics education undergraduates.

1.4.1 Epistemological Beliefs

In the epistemological beliefs aspect, the research objectives are to determine:-

i. the epistemological beliefs towards Physics and learning Physics held by the Physics education undergraduates.

ii. if there is any significant difference in epistemological beliefs between male and female undergraduates.

iii. if there is any significant difference in epistemological beliefs between First Year and Final Year undergraduates.

1.4.2 Learning Attitudes

In the learning attitudes aspect, the research objectives are to determine:-

i. the attitudes towards learning Physics among Physics education undergraduates.

ii. if there is any significant difference in learning attitudes between male and female undergraduates.

iii. if there is any significant difference in learning attitudes between First Year and Final Year undergraduates.

1.4.3 Conceptual Understanding

In the conceptual understanding aspect, the research objectives are to determine:-

i. the level of conceptual understanding in Newtonian force concept among Physics education undergraduates.

ii. if there is any significant difference in conceptual understanding between male and female undergraduates.

iii. if there is any significant difference in conceptual understanding between First Year and Final Year undergraduates.

1.4.4 Relationships between Epistemological Beliefs, Learning Attitudes and Conceptual Understanding

In this aspect, the research objective is to determine:-

i. if there is any significant relationship between epistemological beliefs, learning attitudes and conceptual understanding among the Physics education undergraduates.

1.5 Research Questions

This research is carried out in Universiti Teknologi Malaysia to answer the following research questions related to the epistemological beliefs, learning attitudes and conceptual understanding of Physics education undergraduates. There are a total of 10 research questions in this research. The following part show the research questions identified in each aspect studied.

1.5.1 Epistemological Beliefs

In the epistemological beliefs aspect, the research questions are as followed:-

i. What are the epistemological beliefs towards Physics and learning Physics held by the undergraduates?

ii. Is there any significant difference in epistemological beliefs between male and female undergraduates?

iii. Is there any significant difference in epistemological beliefs between First Year and Final Year undergraduates?

1.5.2 Learning Attitudes

In the learning attitudes aspect, the research questions are as followed:-

i. What are the attitudes of Physics education undergraduates towards learning Physics?

ii. Is there any significant difference in learning attitudes between male and female undergraduates?

iii. Is there any significant difference in learning attitudes between First Year and Final Year undergraduates?

1.5.3 Conceptual Understanding

In the conceptual understanding aspect, the research questions are as followed:-

i. What is the level of conceptual understanding in Newtonian force concept among the undergraduates?

ii. Is there any significant difference in conceptual understanding between male and female undergraduates?

iii. Is there any significant difference in learning attitudes between First Year and Final Year undergraduates?

1.5.4 Relationships between Epistemological Beliefs, Learning Attitudes and Conceptual Understanding

In this aspect, the research question is as followed:-

i. Is there any significant relationship between epistemological beliefs, learning attitudes and conceptual understanding among the Physics education undergraduates?

1.6 Research Hypotheses

The following statements are the null hypotheses related to the aspects studied in the research like epistemological beliefs, learning attitudes and conceptual understanding.

1.6.1 Epistemological Beliefs

In the epistemological beliefs aspect, the null hypotheses are as followed:-

i. There is no significant difference in epistemological beliefs between male and female undergraduates.

ii. There is no significant difference in epistemological beliefs between First Year and Final year undergraduates.

1.6.2 Learning Attitudes

In the learning attitudes aspect, the null hypotheses are as followed:-

i. There is no significant difference in learning attitudes between male and female undergraduates.

ii. There is no significant difference in learning attitudes between First Year and Final year undergraduates.

1.6.3 Conceptual Understanding

In the conceptual understanding aspect, the null hypotheses are as followed:-

i. There is no significant difference in conceptual understanding between male and female undergraduates.

ii. There is no significant difference in conceptual understanding between First Year and Final year undergraduates.

1.6.4 Relationships between Epistemological Beliefs, Learning Attitudes and Conceptual Understanding

In the relationships between epistemological beliefs, learning attitudes and conceptual understanding aspect, the null hypotheses are as followed:-

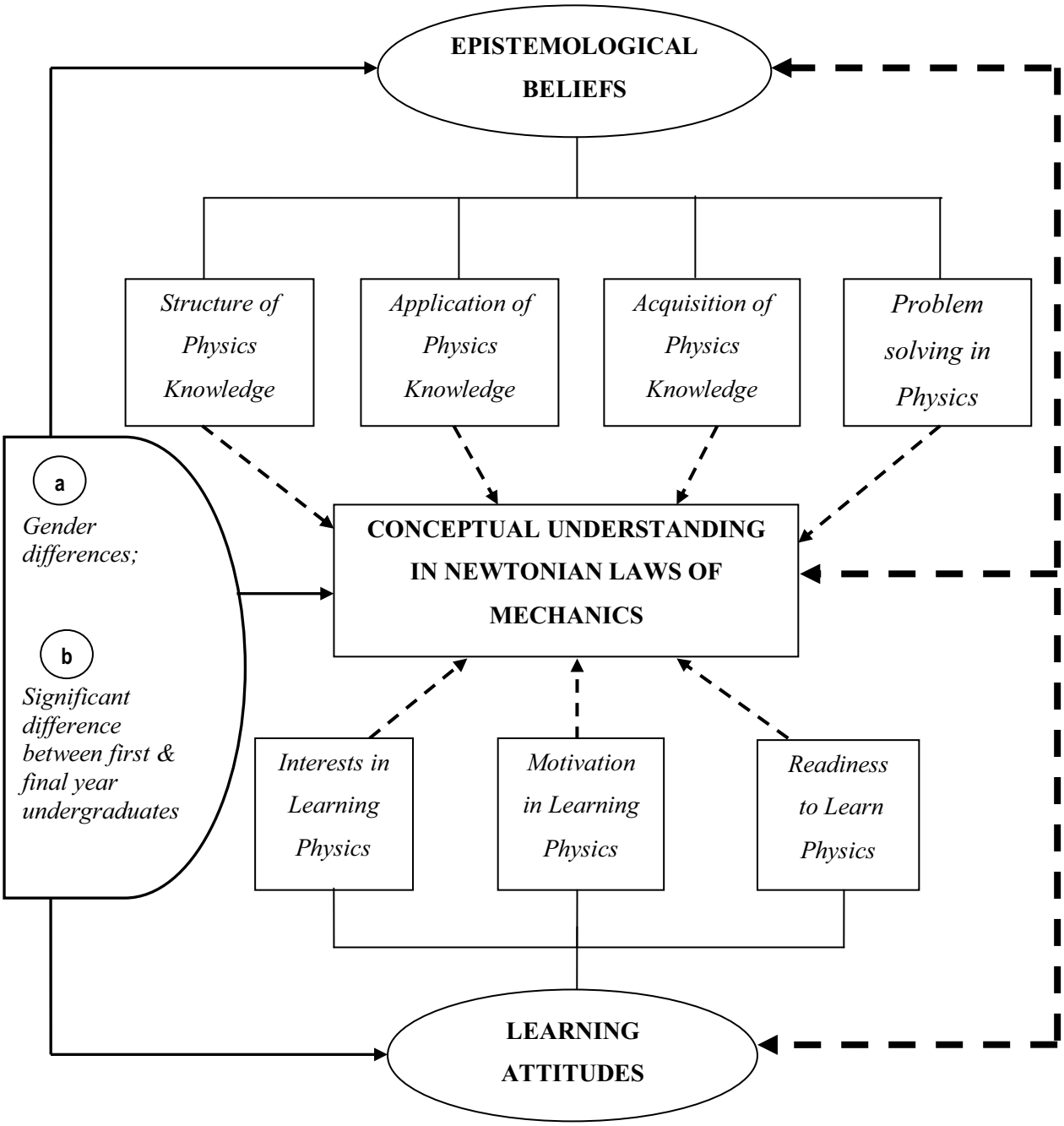
i. There is no significant relationship between epistemological beliefs and learning attitudes among the Physics education undergraduates.

ii. There is no significant relationship between epistemological beliefs and conceptual understanding among the Physics education undergraduates.

iii. There is no significant relationship between learning attitudes and conceptual understanding among the Physics education undergraduates.

1.7 Conceptual Framework of the Research

There are three main variables studied in this research as this research is intended to investigate the Universiti Teknologi Malaysia, Physics education undergraduates' epistemological beliefs, learning attitudes in Physics as well as to study the undergraduates' conceptual understanding in Newtonian force concept. Figure 1.1 shows the conceptual framework on the study of Epistemological Beliefs, Learning Attitudes and Conceptual Understanding towards Learning Physics among Physics education undergraduates. It shows the three main independent variables involved in the study, namely Epistemological Beliefs (EB), Learning Attitudes (LA) and Conceptual Understanding (CU). In this study, four components of epistemological beliefs to be studied are the structure of Physics knowledge, the application of Physics knowledge, the acquisition of Physics knowledge and the problem solving in Physics. The components mentioned are the subscales for the epistemological beliefs aspect. On the other hand, the learning attitudes aspect will look into the components like students' interests, motivation and readiness to learn the Physics subject. In the conceptual understanding aspect, the undergraduates' conceptual understanding in Newtonian force concept is the component to be studied. The research is to look into each variable accordingly and investigate any significant relationship that might exist between them. Firstly, the research is to measure the epistemological beliefs, learning attitudes and conceptual understanding variables among the Physics education undergraduates. Secondly, the research is to examine any significant difference across gender for each variable. Thirdly, the research is to examine any significant difference between first and final year undergraduates for each variable. Lastly, the study is to investigate any significant relationship between those three variables.



Legend:

- - - -► To study if there is any significant relationship exists between the variables

——► To study: a) the gender differences,

b) the significant difference between first & final year undergraduates in each subscale of EB, LA and CU categories

Figure 1.1 : Conceptual framework of the research

1.8 The Importance of the Research

The main purpose of the research is to investigate students' epistemological beliefs and attitudes towards Physics and learning Physics. At the same time it is also to study the students' strength or ability to master the conceptual understanding of Newtonian force concept. Apart from that, the research is also to study the relationship between students' epistemological beliefs and attitudes as well as their conceptual understanding in Physics. In other words is to investigate whether Physics-related epistemological beliefs and learning attitudes are good predictor of students' conceptual understanding in Physics.

To study the teachers' epistemological beliefs and attitudes is important as it helps to understand the teachers' thinking processes, classroom practices, openness to change, and motivations to teach (Voltaire, 2006). The findings of this research will help the educators, Physics educators in particular to get an idea on how the students are thinking, their personal epistemological beliefs, perceptions and attitudes towards learning Physics. The respondents involved in this research are Physics education students and they are the pre-service Physics teachers in our country. To study and understand the epistemological beliefs and attitudes of this group of future Physics teachers is important as their attitudes and competencies in learning Physics may characterize our future generation of Physics teacher's traits and behaviors during teaching in future (Barros and Elia, 1998). At the same time, the study also help the educators to get an overview on how the students are performing in solving problems related to Newtonian force concept. Students' achievement in solving the force and motion problems will reflect their level of understanding and mastery in Newtonian force concept. Furthermore, having students' views about their epistemological beliefs and attitudes towards Physics can provide valuable information to the course instructors preparing the course curriculum, choosing the course textbooks, and employing the curriculum in a way that lessens students' difficulties of understanding and learning of Physics. The achievement in force and motion conceptual understanding test will also serve as an indicator for the students themselves on how well they manage to solve the problems and how deep their degree of conceptual understanding in learning the fundamental concept of Physics. Apart from that, the study also helps Physics instructors to

identify the beliefs, perception, attitudes and interests of students towards Physics and will serve as a guide for them to plan their teaching strategy in order to create an effective teaching atmosphere that will help students to like and understand Physics better during the course of study.

1.9 Scope of Study

The group of students targeted for this study are Physics majored undergraduates from Faculty of Education, Universiti Teknologi Malaysia. The respondents in this study are First Year and Final Year Physics education students. The scope of this study is to probe the undergraduates' epistemological beliefs, learning attitudes and conceptual understanding in Physics.

The scope focuses on three main aspects which are:-

a) Physics education undergraduates' epistemological beliefs towards Physics and learning Physics.
b) Physics education undergraduates' attitudes in learning Physics.
c) Physics education undergraduates' conceptual understanding in Newtonian force concept.

The conceptual understanding aspect studied in this research is focusing on Introductory Physics Force and Motion Concept. The Newtonian force concept inventory consists of problems which related to topics that involved Force and Motion in the like of Kinematics, Newton's First Law, Newton's Second Law and Newton's Third Law.

1.10 Limitation of Research

The respondents for this study are Physics education undergraduates from Faculty of Education, Universiti Teknologi Malaysia. Hence, the results obtained in the study cannot be generalized to all the students in the university because the research only involved the Physics education undergraduates. The study on the students' conceptual understanding in learning Physics only focus on the topic of Newtonian force concept. As for the learning attitudes, it only focuses on the affective and behavioral components, namely Interest, Motivation and Readiness in Learning Physics. According to Berg (2005), if university teachers were asked, what is the most important student characteristic associated with successful studies, they usually mention traits such as attitude, motivation and genuine interest.

1.11 Operational Definition

The operational definition is to describe the words used in this study according to the context of the study. The constructs, namely, epistemological beliefs, attitudes and conceptual understanding used in the study are described as follow.

1.11.1 Epistemological Beliefs

As mentioned earlier, Kortemeyer (2007) described epistemological beliefs about Physics and Physics learning as the beliefs which concern with what constitutes knowledge in Physics and how knowledge in Physics is developed. The constructs measured here are to examine students' beliefs on how Physics knowledge is constructed, evaluated and their perceptions on the nature of Physics knowledge itself. The epistemological beliefs component will look into aspects like students' beliefs towards the Structure of Physics Knowledge, Application of Physics Knowledge, Acquisition of Physics Knowledge and Problem solving in

Physics. The sophistication of epistemological beliefs is measured by using Physics Epistemological Beliefs and Attitudes Test (PEBAT).

1.11.2 Sophistication of Epistemological Beliefs

Sophistication of epistemological beliefs in the context here represents the degree or level of epistemological beliefs measured. Pullmones (2010) uses the terms sophisticated epistemology and naïve epistemology to indicate high and low sophistication of epistemological beliefs respectively. Stathopoulou and Vosniadou (2006) too use the term sophistication of epistemological beliefs as an indicator to show the level of epistemological beliefs measured in their study. In this study, the level of epistemological beliefs measured is represented by the sophistication of epistemological beliefs.

1.11.3 Attitudes

An attitude is a hypothetical construct that represents an individual's degree of like or dislike towards something and is based upon cognitions, affective reaction and behavioral intentions (Rosenberg and Hovland, 1960). Attitudes in the context here are one's judgment and generally are regarded as positive or negative views of Physics learning. The construct measured here will look at different aspects like the students' Interests, Motivation and Readiness to learn the Physics subject. The learning attitudes variable is measured by using Physics Epistemological Beliefs and Attitudes Test (PEBAT).

1.11.4 Conceptual Understanding

Conceptual understanding refers to an ability to recognize underlying concepts in a variety of different representations and applications (Richardson and McCallum, 2003). This study is to evaluate students' conceptual understanding in Newtonian force concepts. The concepts covered include Kinematics, Newton's First Law, Newton's Second Law, Newton's Third Law, Superposition Principle and Kinds of Force. The conceptual understanding variable involved in this study is measured by using Force Concept Inventory (FCI) developed by Hestenes *et al.* (1992).

1.11.5 Misconception

Misconception in the science learning context refers to preconceived notions, non-scientific beliefs, or conceptual misunderstandings (Hestenes *et al.*, 1992). In science these are cases in which something a person knows or believes does not match with what is known to be scientifically correct. In this study, the misconception detected is also known as Aristotelian beliefs as it is not compatible with the Newtonian thinking.

1.12 Conclusion

This research is aimed to study undergraduates' epistemological beliefs and learning attitudes towards Physics and to investigate students' conceptual understanding in Newtonian Laws of Physics. The results of the study are important as they help Physics educationists to understand how students think about Physics knowledge, how Physics knowledge is acquired by students, how students react and their approaches towards the process of learning Physics. Apart from that, the study also helps to provide information on the students' achievement and degree of

understanding in basic Physics concept such as Newtonian force concept. Hopefully with the information gained via this study, Physics educationists can plan certain teaching strategy to teach Physics in order to increase students' interests towards Physics and to ensure effective learning among the students in acquiring the knowledge of Physics.